

CLAIMS

What is claimed is:

- Sub A* 5
1. A method for forming hardened semiconductor interconnects comprising:
depositing a metal layer on a semiconductor wafer surface;
introducing additional metal species into said metal layer; and
performing chemical-mechanical polishing of said deposited metal layer
wherein said additional metal species hardens said deposited metal layer to
reduce the rate of said polishing.

10

- D1*
2. The method of claim 1, wherein said deposited metal layer is copper.
 3. The method of claim 2, wherein said additional metal species is beryllium.
 - 15 4. The method of claim 3, wherein the beryllium forms a solid solution in
said deposited copper layer.

- Sub A 20*
5. A method for forming hardened semiconductor interconnects comprising:
depositing metal layers on a semiconductor wafer surface;
introducing additional metal species;
heating the deposited metal film with the introduced metal species;

allowing the heated metal film to cool, so as to form precipitates of said introduced metal species; and

performing chemical-mechanical polishing wherein said additional metal precipitate hardens said deposited metal layer to reduce the rate of said
5 polishing.

6. The method of claim 5, wherein the deposited metal layer is copper.

7. The method of claim 5, wherein the additional metal species is beryllium.

8. A method for forming hardened semiconductor interconnects comprising:

depositing metal layers on a semiconductor wafer surface;
introducing additional metal species;
heating the deposited metal film with said introduced metal species in an
15 oxidizing atmosphere to oxidize said additional metal species; and
performing chemical-mechanical polishing wherein said oxidized
additional metal species hardens said deposited metal layer to reduce the rate of
said polishing.

20 9. The method of claim 8, wherein said deposited metal layer is copper.

10. The method of claim 8, wherein the additional metal species is aluminum.

11. The method of claim 10, where the oxidized aluminum in the copper layer forms oxide dispersion-strengthened copper.

5 12. A method for hardening semiconductor device interconnects comprising:
fabricating an oxide-dispersion hardened metal sputtering target; and
sputtering said oxide-dispersion hardened metal directly onto the
semiconductor dielectric layer.

10 13. The method of claim 12, wherein the deposited oxide-dispersion hardened metal layer is copper with an aluminum oxide solute.

14. A semiconductor device, comprising:

a silicon substrate;
at least one dielectric layer deposited on said substrate;
trenches etched through said dielectric layer, so as to allow connection of a second layer to the silicon substrate below;
at least one metal layer deposited on top of said dielectric layer, with said metal filling said trenches in said dielectric layer;
20 a second metal dispersed throughout said metal layer, the combination thereof forming a layer of metal of differing hardness than the pure metal; and
a second layer of dielectric over said contiguous metal layer.

15. The metal layer of claim 14, wherein said metal layer is dispersion-hardened.

5 16. The metal layer of claim 14, wherein said metal layer is precipitation-hardened.

17. The metal layer of claim 14, wherein said metal layer is oxide-dispersion hardened.

Add 1
A³